Exploring the Energy/Water Nexus: A Stakeholder Dialogue for Identification of Critical Issues

Forum Summary - February 25, 2005
National Renewable Energy Laboratory (NREL) Stakeholder Technology Forum

Reliable and secure energy – as well as freshwater supplies – are vital to the prosperity of our nation, and are a growing challenge in the American West. Energy and water are increasingly interdependent, with electric power generation requiring large quantities of water, while oil and gas production produces large quantities of wastewater. The electricity industry is second to agriculture as the largest user of water in the United States. Similarly, potable water sourcing, treatment, and distribution require considerable amounts of energy.

The National Renewable Energy Laboratory (NREL) recently hosted a technology forum, which included more than 40 stakeholders, to discuss some of the issues surrounding energy and water. Organized with the U.S. Environmental Protection Agency, U.S. Geological Survey, U.S. Bureau of Reclamation, Western Area Power Administration, and Colorado Water Resource Research Institute, the workshop explored the energy/water nexus with a focus on energy's impact in water development and quality, and water use and quality in energy production and delivery.

Participants identified issues that are critical to ensuring that our energy supply supports water availability and quality; reduces water use in the supply of energy; and advances energy and water sustainability for Colorado, the Rocky Mountains, and the Great Plains.

The two primary sessions discussed energy demand for the public water supply and exploration of water and energy supply linkages.

Questions discussed included:

1. What are critical issues related to ensuring adequate energy supply to support water availability and quality?
2. What are the critical issues related to reduced energy demand in water supply, treatment, and transportation?
3. What are the critical issues related to reducing water use in the supply of energy from the range of fuel sources?

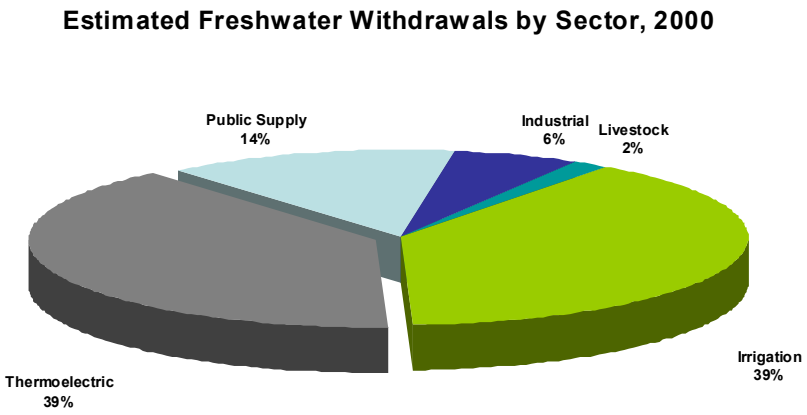
4. What are the critical issues related to energy and water security for Colorado, the Rocky Mountains, the Great Plains?
5. How might increased use of renewable energy technologies and energy efficiency measures impact water availability and quality?

Stan Bull of NREL opened the forum, outlining the goals for the event. With the ever-increasing link between energy and water (functionally and geographically), the Lab realized the critical need for research and solutions, and the importance of building new relationships among key organizations.

The keynote, titled "Critical Issues in the West," was presented by Pam Inmann of the Western Governors' Association. Her talk emphasized the Governors' commitments to water issues, drought preparedness, and clean energy. Through the joint efforts of the Western States Water Council and the Western Interstate Energy Board, the Western Governors' Association has multiple forums to address the energy-water nexus. The first session, titled "Energy Demands for Public Water Supply," included four speakers/panelists[1]:

- Bob Wilkinson, University of California (Santa Barbara), moderator
- Linda Reekie, Awwa Research Foundation
- Todd Bartholf, CH2M Hill
- Larry Flowers, NREL

The panelists highlighted an increasing body of work that is focused on municipal and agricultural water and energy issues. Key drivers include: emerging technologies, security, marginal water supply, regulation, costs, and economic opportunities.



In the second session, "Water for Energy: Exploring Water and Energy Supply," speakers/panelists included:

- Maryanne Bach, U.S. Bureau of Reclamation, moderator
- Bill Karsell, U.S. Bureau of Reclamation
- Wayne Vanderschuere, Colorado Springs Utilities

[1] Presentations are available at http://www.nrel.gov/analysis/workshops/water_nexus_pres.html

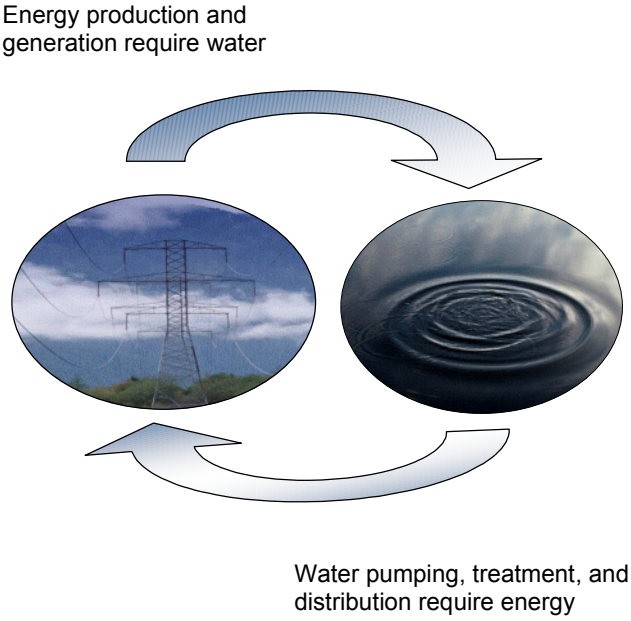
Karsell highlighted a new approach to life-cycle assessment of energy generation, while Vanderschuere highlighted an integrated approach to managing energy and water, which allows for new opportunities for cross-fertilization when viewed from a holistic approach.

Discussion of the Energy/Water Nexus: Similarities in the Context for Policy

General links and relationships: energy intensity of water and water intensity of energy.
Electricity and water do mix: Electricity is used to move water, and electricity is made from falling waters.

Energy intensity, or embodied energy, is the total amount of energy, calculated on a whole-system basis, required for the use of a given amount of water in a specific location.

There are four principle energy elements in water systems. Pumping water in each of these four stages is energy-intensive and constitutes a major use of energy:



1. primary water extraction, conveyance, storage (in some cases), and supply delivery (imported and local)
2. treatment and distribution within service areas
3. on-site water pumping, treatment, and thermal inputs (heating and cooling)
4. wastewater collection and treatment

Two primary areas were discussed. The first was the need for informing policy and management. Specifically, the participants discussed questions related to the information needed to inform policy, including:

1. Where and when will water systems use more energy (e.g. desalination)?
2. Where and when will water systems use less energy (e.g. efficiency improvements, reuse, shift is supply options, etc.)?
3. What information and data do we need to support good policy?

Further discussions focused on "new" management approaches, where the group addressed possible areas for improvement in managing water issues:

1. Integrated management (water, wastewater, stormwater, energy, …)
2. Multiple benefits (policy and investments)
3. Portfolio strategies (supply, management, risk, cost)

Members of the group found they had similar challenges for water and energy management:

- Reliability (supply)
- Cost (supply and quality)
- Quality (for various uses)
- Environmental Impacts

> "The new paradigm of this century is water supply issues will no longer be driven by droughts. We will have conflict in normal years, and that conflict will affect economies of national importance. The demands for water in many basins of the West exceed the available supply even in normal years."
>
> Bennett Raley, Assistant Interior Secretary for Water and Science *Las Vegas Review-Journal* - 3/10/04

They also agreed that there were similarities in policy context:

- Historic supply-side orientation
- Infrastructure is important
- Huge end-use efficiency opportunities
- New technologies are changing our notions of optimal scale
- Market distortions and disconnect between pricing and cost

> "During the last decade, the arena of long-term water resources planning has been broadened to include conservation as a promising management alternative. Water supplies are currently undergoing the same change which took place in the energy industry during the 1970s."
>
> Metropolitan Water District, 1990 *Water Management Plan*

NOTE: The *Energy Policy Act* of 1992 established national standards set for plumbing fixtures, although many states had already adopted similar standards on their own. (The act sets minimum water efficiency standards at the federal level for plumbing fixtures.)

Outcome and Action Plan

Four major topic areas were identified:

1. Policy and legal issues
2. Technology issues (from infrastructure to treatment/filtering technology, end-use technologies, etc.)
3. Economic issues (capital and operating cost factors, life-cycle cost/benefit, pricing, etc.)
4. Science issues (from hydrology and impacts of climate change to water quality issues and measurement of pollutants)

Management and planning opportunities

1. Fully integrated management strategies (building on integrated resource management efforts in energy and water management, develop management strategies that incorporate water, wastewater, stormwater, energy, and other elements)
2. Use of portfolio approaches for management (beyond diversification, to include cost/benefit and risk/return information)
3. Planning and forecasting (understanding both energy and water demands – as a function of price and what people are willing to pay, and as it related to technology developments, particularly on the end-use side)

The group reached consensus that further effort is warranted in each of the topical areas identified above, and agreed to address them through specific case studies and further research and publication of analysis of the critical issues.

Participant Feedback

A Web-based survey was sent to workshop participants following the event. More than 90% of survey respondents indicated they would participate in follow-on activities and workshops. In general, respondents desired to develop a clear set of objectives and action items, and indicated that future workshops should focus on substantive and specific issues.

Workshop participants found value in the diversity of presenters and interests represented at the workshop. Respondents noted that more in-depth analysis and data on energy/water issues was needed. Respondents also would have valued additional time for networking, discussion, and strategic brainstorming to identify a framework for partnership.

Potential areas for collaboration identified by respondents included developing objectives and actions on a number of issues, such as regional analyses of energy demands and supplies, regional water demands and supplies, and population and climate scenarios. Respondents desired more focused workshop sessions, which are focused on a particular area or issue.

More Information

Participants can access more background information on NREL's Energy Analysis Web site at http://www.nrel.gov/analysis/workshops/water_nexus_workshop.html, as well as the presentations at http://www.nrel.gov/analysis/workshops/water_nexus_pres.html.